TOPOGRAPHY OF THE SOUTH POLAR REGION FROM CLEMENTINE STEREO IMAGING. Paul D. Spudis[1], Tony Cook[2], Mark Robinson[3], Ben Bussey[4] , and Brian Fessler[1] 1. Lunar and Planetary Institute, Houston TX 77058 (spudis@lpi.jsc.nasa.gov) 2. CEPS-NASM, Smithsonian Institution, Washington DC 3. Northwestern Univ., Evanston, IL 60208 4. ESTEC, ESA, 2200 AG Noordwijk, NL

The Clementine spacecraft made the first near-global topographic map (referenced to a mean lunar radius of 1738 km) of the Moon from laser altimetry (LA; [1]). Because the spacecraft was in an elliptical orbit and the laser ranger could not detect returns when the spacecraft was farther than 600 km from the Moon, we do not possess ranging data for latitudes within 15° of the poles [2]. However, the UV-VIS imager on Clementine obtained images from different perspectives in space from which stereo information may be derived and topographic models produced [3]. The poles were especially well covered in stereo and we have used images of the south pole area to infer topographic information in areas not sampled by the laser altimeter. We here describe preliminary results in our construction of a Digital Elevation Model (DEM) of the south polar area of the Moon.

Method. The south polar DEM was created by processing systematically several orbital strips of Clementine UVVIS images [3, 4]. Common points between overlapping images were initially chosen manually. These points were used by an automated patch-based correlation stereo matcher, to find all corresponding points on a grid spacing of 3 pixels, in the overlap region between images on each given orbit. The matched image points were fed through a stereo intersection camera model, using nominal camera pointing to produce relative height Digital Terrain Model (DTM) tiles of longitude, latitude, and height. An iterative fitting procedure followed whereby DTM tiles were fitted in elevation to laser altimeter points, and then for the remaining tiles with no underlying altimeter measurement, to previous adjacent fitted tiles. South of 78° latitude, DTM tiles form islands for which the absolute elevation is unknown due to lack of altimeter measurements or connectivity to fixed adjacent tiles. In such cases these have been fitted to interpolated altimeter measurements, and therefore heights measured in this area are relative to each island DTM. A 1 km pixel size Digital Elevation Model (DEM) mosaic, in polar stereographic projection was produced from the collection of DTM tiles that resulted. This DEM was merged with existing Clementine LA data to study the topography of the polar area.

Results. The merged data set is shown in Figure 1 and an elevation color-coded version is shown in Figure 2. Note that the stereo DEM has significantly better resolution (~ 1 km) than the LA data (~50 km). But equally importantly, the new DEM extends topographic coverage into the south polar region. We have previously described an area on the rim of the crater Shackleton that appears to be illuminated by sunlight for more than 70% of the lunar day [5]; this means that it must be elevated above the mean lunar radius on the order of + 600 m. In the new data, the rim of the Shackleton crater is 1.0 km ± 0.6 km above the surrounding terrain within 10 km of the crater and within 30 km of the south pole, the dynamic range of elevation is at least 2.8 km. Within 150 km of the pole on the far side, the dynamic range of elevation is at least 6.5 km, with spot elevations as low as -9.4 km around 87.2° S, 180°. Within 150 km of the pole on the near side, the dynamic range in elevation is at least 7.9 km. This spot on our merged elevation image (Figure 2) occurs at an elevation of about + 0.5 km, in accordance with the predictions of our illumination study [5].

The South Pole-Aitken basin was revealed by Clementine to be the largest known impact crater in the solar system, with a diameter of about 2600 km and a maximum depth of almost 12 km [6]. The new coverage shows prominent topography associated with SPA basin occurring near 75° S between 0° and 30° E longitude. These massifs, known from Earth-based telescopic study as the Liebnitz Mountains [e.g., 7], crest between +4 and +5 km elevation. The basin wall extends over the polar region, from about 70° S on the near side to about 85° S at 180° longitude, a distance of about 800 km. In this span, the elevation drops over 10 km, from ~ + 4 km

to about -6 km elevation (Figure 2). This slope is comparable to and symmetric with basin wall slopes elsewhere around the eastern far side of SPA basin (e.g., south of Korolev at 12° S, 160° W, the basin rim crest stands at almost + 7 km and slopes down to - 5 km, a drop of 12 km over about a 600 km span. Thus, the new topographic data suggest that SPA basin shows prominent rim crest symmetry, at least over more than 180° of its circumference.

These topographic data are preliminary and we plan to refine and extend the stereo model to cover as much of the south polar region and the Moon as possible.

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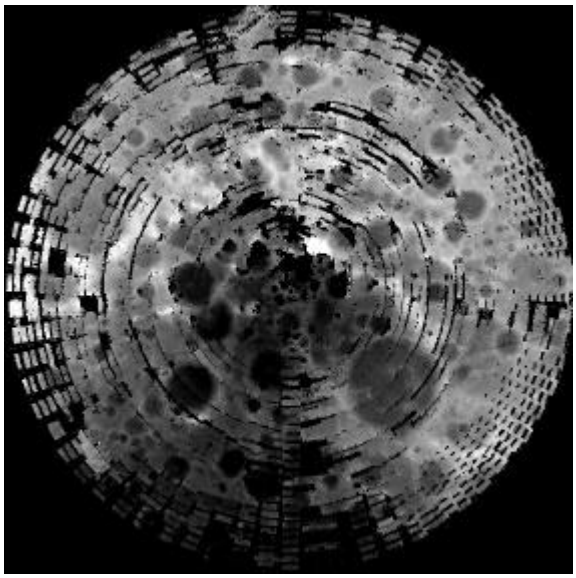

Figure 1. Stereo DEM overlain on Clementine LA base image. Polar stereographic projection.

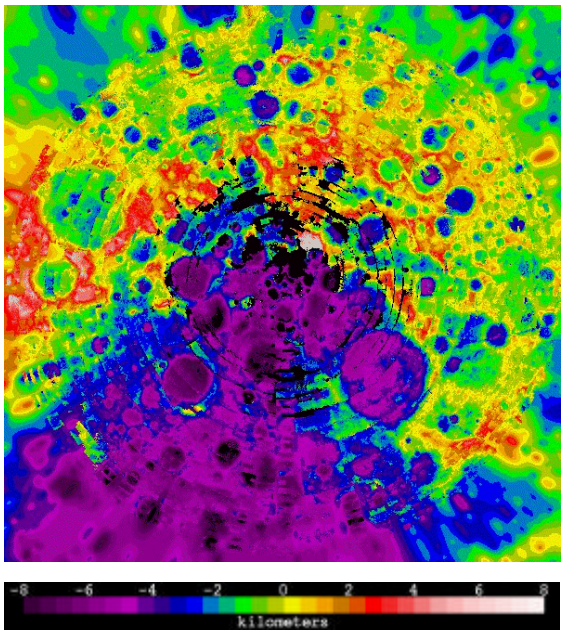

Figure 2. Topographic map of the south polar region of the Moon, including both Clementine LA data and the newly derived DEM.